

Claims

What is claimed is:

1. An exhaust gas recirculation valve comprising:  
an exhaust passage tube;  
a valve element pivotally mounted within the exhaust passage tube;  
a linear actuator; and  
a gear train including a rack gear operatively connected to the linear actuator, the rack gear adapted to move in a substantially linear direction upon activation of the linear actuator, and at least one rotatable gear meshing with the rack gear and operatively connected to the valve element to cause rotation of the valve element upon actuation of the linear actuator.
2. The apparatus of claim 1, wherein the linear actuator is mounted to the exhaust passage tube.
3. The apparatus of claim 1, wherein the exhaust passage tube is aligned along an axis and the linear direction is parallel to the axis.
4. The apparatus of claim 1, wherein the rack gear includes teeth disposed on a rod directly driven by the linear actuator.
5. The apparatus of claim 1, further including a return spring operatively connected to the rack gear for biasing the rack gear to a non-actuated position.
6. The apparatus of claim 1, further including an adjustable stop mechanism for limiting the rotational travel of the valve element.

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7. The apparatus of claim 6, wherein the adjustable stop mechanism includes a stop lever operatively connected to the valve element for rotation therewith.

8. The apparatus of claim 1, wherein the linear actuator is a solenoid.

9. The apparatus of claim 1, wherein the valve element is mounted to a spindle and the gear train includes a rotatable gear mounted to the spindle.

10. The apparatus of claim 1, further including an adjustable stop mechanism for limiting the rotational travel of the valve element.

11. The apparatus of claim 10, wherein the adjustable stop mechanism includes a stop lever mounted to the spindle.

12. The apparatus of claim 1, wherein the gear train includes a plurality of rotatable gears.

13. The apparatus of claim 12, wherein the rack gear is disposed along at least a portion of the length of the actuator rod.

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14. An exhaust gas recirculation valve comprising:  
an exhaust passage tube having a first axis;  
a valve element pivotally mounted within the exhaust  
passage tube;  
an apparatus adapted for linear movement along a second  
axis substantially parallel to the first axis, the apparatus adapted for linear  
movement along the second axis adapted to be selectively activated;  
an actuator rod directly driven by the apparatus adapted for  
linear movement along the second axis, the actuator rod adapted to move in a  
substantially linear direction upon activation of the apparatus adapted for linear  
movement along the second axis; and  
a gear train including a rack gear, disposed along at least a  
portion of the length of the actuator rod, and at least one rotatable gear meshing  
with the rack gear, the rotatable gear being operatively connected to the valve  
element and adapted to cause rotation of the valve element upon actuation of the  
apparatus adapted for linear movement along the second axis.
15. The apparatus of claim 14, further including a return spring  
operatively connected to the actuator rod for returning the actuator rod to a non-  
actuated position when the apparatus adapted for linear movement along the  
second axis is not activated.
16. The apparatus of claim 14, further including an adjustable  
stop mechanism for limiting the rotational travel of the valve element.
17. The apparatus of claim 16, wherein the adjustable stop  
mechanism includes a stop lever operatively connected to the valve element for  
rotation therewith.

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18. A method of actuating an exhaust gas recirculation valve, the method comprising the steps of:

energizing a linear actuator;

moving a rack gear operatively connected to the linear actuator; and

rotating at least one rotatable gear operatively connected with a valve element to thereby rotate the valve element.

19. The method of claim 18, wherein the energizing step includes providing electrical current to a solenoid.

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